



## **Medial humeral epicondylitis in cats**

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**Abstract:** **OBJECTIVE:** To describe medial humeral epicondylitis in cats based on radiographic, anatomic, and histologic observations. **STUDY DESIGN:** Prospective cohort study. **ANIMALS:** Feline cadavers (n = 60). **METHODS:** Extended craniocaudal, and extended and flexed mediolateral radiographic projections were taken of both elbows of 60 consecutive European shorthair cats that died or were euthanatized. Elbows with new bone formation at the medial epicondyle were dissected and embedded in methyl-methacrylate (MMA). For comparison, both elbows of a cat with no radiographic changes were prepared in a similar manner. Sections of the MMA blocks were Giemsa stained and examined with light microscopy. **RESULTS:** Bilateral new bone formation was identified radiographically at the medial aspect of the humeral epicondyle in 6 cats (10%). All of these cats had mineral deposition in the humeral head of the flexor carpi ulnaris muscle. Other findings were cartilage damage (n = 3 cats), an additional loose medial joint body (1), and tendinosis (3). The ulnar nerve was flattened and displaced caudally, and signs of chronic epineural fibrosis were present in 2 severely affected cats. **CONCLUSIONS:** Ten percent of this feline population had radiographic evidence of medial humeral epicondylitis with chronic degeneration, mineralization, and metaplastic bone formation in damaged fibrillar matrix involving the origin of the humeral head of the flexor carpi ulnaris muscle. New bone formation caused displacement and compression of the ulnar nerve in severely affected elbows. Based on our findings, medial humeral epicondylitis appears to be a common disorder in cats with potential clinical sequelae.

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**RUNNING HEAD:** Medial Humeral Epicondylitis in Cats

Medial Humeral Epicondylitis in Cats

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## **Abstract**

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**Methods:** Extended craniocaudal, and extended and flexed mediolateral radiographic projections were taken of both elbows of 60 consecutive European shorthair cats that died or were euthanatized. Elbows with new bone formation at the medial epicondyle were dissected and embedded in methyl-methacrylate (MMA). For comparison, both elbows of a cat with no radiographic changes were prepared **in a similar manner**. Sections of the MMA blocks were Giemsa stained and examined with light microscopy.

**Results:** Bilateral new bone formation was identified at the medial aspect of the humeral epicondyle in 6 cats (10%). All of these cats had mineral deposition in the humeral head of the flexor carpi ulnaris muscle. Other findings were cartilage damage (n = 3 cats), an additional loose medial joint body (1), and tendinosis (3). The ulnar nerve was flattened and displaced caudally, and signs of chronic epineural fibrosis were present in 2 severely affected cats.

**Conclusions:** Ten percent of this feline population had radiographic evidence of medial humeral epicondylitis with chronic degeneration, mineralization, and metaplastic bone formation in damaged fibrillar matrix involving the origin of the humeral head of the flexor carpi ulnaris muscle. New bone formation caused displacement and compression of the ulnar nerve in severely affected elbows. Based on our findings, medial humeral epicondylitis appears to be a common disorder in cats with potential clinical sequelae.

## INTRODUCTION

People participating in athletic activities may develop lateral (tennis elbow) or medial humeral epicondylitis depending on the mechanical demands on the elbow and its muscular attachments, **inherent** to the type of sport activity. Both types of epicondylitis are caused by repetitive overuse injuries. Medial humeral epicondylitis in people is usually associated with sports like baseball and golf. In children, overuse injuries can lead to medial epicondylar apophysitis and epicondylar avulsion fractures referred to as little leaguer's elbow.<sup>1-7</sup>

Although cats are often reported to suffer from elbow lameness, causes and pathophysiology of elbow lameness are poorly described<sup>8-13</sup> and most previous attempts to characterize feline elbow joint disease are limited to radiographic descriptions.<sup>8,14,15</sup> New bone formation at the medial aspect of the feline elbow joint has generally been ascribed to osteoarthritis.<sup>10,13,16,17</sup> Although enthesiopathies or insertion tendinopathies of the elbow are described in dogs with and without lameness, medial epicondylitis is rarely described in cats.<sup>18-24</sup>

We evaluated elbow joints in a randomly selected population of European cats to investigate the frequency of medial epicondylitis and compare the radiographic appearance and histologic findings of affected elbow joints.

## **MATERIALS AND METHODS**

A prospective study was performed on 60 European shorthair cats, referred consecutively to our hospital from November 2010 to March 2011. Cats were included if they died or were euthanatized for medical reasons other than skeletal disorders. Cadavers were studied after obtaining owner consent. Data gathered from the medical records included age, body weight and access to outdoors.

Immediately after death, necropsy examination of the elbows was performed by a single investigator (RS) for gross evidence of joint injury or instability. Stability was assessed with the elbow and carpal joint held at 90° flexion and pronation and supination movements are performed (Campbell's Test). Only elbows with up to ~110° of supination and up to ~70° of pronation were included.<sup>24</sup> In addition, a cat with no clinical history or post-mortem radiographic evidence of skeletal disorders was included as a control.

Based on radiographic and histologic findings, medial humeral epicondylitis was graded as mild, moderate, or severe (Table 1). Mild disease was defined by radiographic small irregularities and/or new bone formation at the medial epicondyle without sclerosis, and neither joint bodies nor cartilage damage found on radiographs or histologically.

Moderate disease was defined by bony spurs at the medial epicondyle, sclerosis, and free mineralized bodies on radiographs, and superficial cartilage erosions that did not reach the subchondral bone on histology. Severe disease was defined by large semicircular new bone formations at the medial aspect of the elbow joint, with subchondral sclerosis and

osteophytes on radiographs, and full-thickness cartilage destruction with exposure of the subchondral bone, with or without bone cavitation on histology.

### *Radiographic Examination*

Immediate post-mortem radiographs of both elbows were performed in maximal flexed mediolateral and maximal extended mediolateral and craniocaudal views in all cats (Figs 1-3). Radiographs were examined for presence or absence of new bone formation at the medial aspect of the humeral epicondyle, as well as other articular changes, including subchondral sclerosis, joint subluxation and mineralized structures at the cranioproximal aspect of the radial head. Elbows with radiographic signs of previous trauma (e.g. fractures) were excluded from study. A diagnosis of medial humeral epicondylitis was based on bony irregularities of the caudodistal edge at the origin of the humeral flexor muscles and presence of caudal periarticular mineralization.

### *Histologic Examination*

All elbows with radiographic changes at the medial aspect of the elbow joint (n=12), as well as both elbows of a control cat (n=2) without radiographic changes were examined histologically. Immediately after death, both thoracic limbs were separated at the glenohumeral joint and the arterial supply of the front limb was fixed by injection of a mixture of 2.5% glutaraldehyde and 1.3% formaldehyde into the axillary artery. The next day, the skin was dissected and the brachium and antebrachium were cut ~4 cm beyond the humeroradial joint. This specimen was fixed for 3 days in the same solution described above. Slow dehydration was then performed by immersion in ascending alcohol

concentrations over 4 days, and cleared in xylol for 8 days. Specimens were then rested and infiltrated in a methyl methacrylate (MMA) mixture (89g MMA, 10g plasticizer [Dibutylphtalat], 0.5g activator [Perkadox®; MMA Brunschwig, Basel, Switzerland]) at room temperature for 3 weeks, and embedded in the same medium at a temperature of 30 °C until polymerization occurred (MMA: Brunschwig; plasticizer Dibutylphtalat: Fluka, Buchs, Switzerland; activator Perkadox 16®: Grogg Chemie, Stettlen-Peisswil, Switzerland). The elbows were maintained in a neutral standing position (extension of ~ 110°).<sup>25,26</sup> MMA-blocks were cut in thick sections of 1.5 mm using a diamond-coated band saw with a kerf of about 500 µm (Exakt 310, Haslab, Ostermündingen, Switzerland). Sections were prepared using a milling machine (Leica SM 2500, Leica Microsystems, Heerbrugg, Switzerland) to achieve sections of 300-600 µm in regions of particular interest. Cuts were made transversely or longitudinally for optimal histologic views. Sections were stained for 15 - 30 minutes with Giemsa and examined under light microscopy.<sup>27</sup>

In addition to sections of elbows with radiographic changes, both elbows of the control cat were prepared similarly for comparison and to assign new bone formation to single anatomic structures. In this cat, each muscle arising from the medial aspect of the elbow joint was marked by colored suture material inserted proximally in the tendon of each muscle origin. Histologic sections were done in a stepwise manner of 1mm. The colored suture material could be differentiated under light-microscope.

## RESULTS

New bone formation was detected on radiographs at the medial humeral epicondyle in both elbows in 6 cats (10%; Figs 1-3). New bone formation was located at the origin of the humeral head of the flexor carpi ulnaris muscle histologically (Figs 4-6). These cats had a median age of 9.7 years (range, 4 - 16 years) and median body weight of 5.0 kg (range, 3.4 - 8.7 kg). Five affected cats had outdoor access (Table 1).

In the control cat without any radiographic evidence of skeletal disorders of the elbow joint, the humeral head of the flexor carpi ulnaris muscle had the most proximal histologic origin on the medial epicondyle. The attachment of the articular capsule to the medial epicondyle was closely connected to the musculotendinous origin of this muscle, completely enclosing the medial epicondyle (Fig 4). In the 6 affected cats, histologic cross sections at that level revealed bilateral new bone formation at the medial humeral epicondyle, attributed to the origin of the humeral head of the flexor carpi ulnaris muscle (Figs 4-6). On radiographs, bilateral rounding and slight irregularities of the medial humeral epicondyle were observed in mild cases of humeral epicondylitis (Fig 1). Pronounced irregular new bone formation with bony spurs on the medial humeral epicondyle was observed in moderate cases (Fig 2) and large semi-circular mineralized structures at the caudomedial aspect of the elbow joint was identified in severe cases (Fig 3). Radiographic evidence of tendon mineralization and/or avulsion of the degenerated humeral head of the flexor carpi ulnaris muscle were also found on histologic examination (Figs 4-6). Indeed, both radiographically and histologically, the mineralized and avulsed structure was distracted onto the more distal part of the caudal joint capsule



in the moderately (cats 3,4) and severely (cats 5,6) affected cats (Figs 2,3,5,6). On radiographs, both elbows of 3 cats (cats 4-6) had mild (Fig 2) to moderate (Fig 3) subluxation of the humeroulnar or humeroradial joint, particularly evident on flexion of the elbow joint. In these cats, superficial (cat 4) or full-thickness (cats 5, 6) cartilage defects were evident bilaterally on histologic examination (Figs 5,6). Mineralization was observed histologically in broader areas of the medial joint capsule in both elbows of cat 5 and 6 (Fig 6). In all radiographically affected elbows, no histologic evidence of avulsion was present at the ulnar attachment of the ulnar head of the flexor carpi ulnaris muscle.

In both elbows of cats 5 and 6, the bony spurs or bone avulsion of the medial humeral epicondyle were found in close contact with the trochlear notch and displaced the ulnar head of the flexor carpi ulnaris muscle caudally on histology (Fig 6). The ulnar head of the flexor carpi ulnaris muscle and the ossified or mineralized part were clearly separated from each other. The ulnar nerve, situated between the humeral head and the ulnar head of the flexor carpi ulnaris muscle, the epitrochleoanconeus muscle and the joint capsule (Fig 4 A), **was adhered to the periosteum and** displaced caudally by the bony mass with advanced mineralization in these 2 severely affected cats. In these cats, the epineurium and the fascicles were flattened and the epineurium revealed increased collagen content. Large adhesions between the outer surfaces of the ossified material and the epineurium were evident histologically (Fig 6).

The incisura trochlearis presented irregular full-thickness cartilage defects accompanied with subchondral bone sclerosis in 1 moderately (cat 4) and 2 severely (cats 5,6) affected cats (Figs 5,6). Osteophytes were also present on the edge of the medial epicondyle in cats 5 and 6 (Figs 3, 6) both radiographically and histologically. An irregular mineralized body was found close to the cranioproximal aspect of the radial head on mediolateral radiographs in both elbows of cats 4 and 6 (Figs 2, 3). Histologically, the bony structure was located within the annular ligament (Fig 8).

A unilateral mineralized intra-articular free body, partially attached to the medial joint capsule, was found histologically in cat 4 (Fig 5B). This was not detectable on radiographs.

Tendinosis of the tendon of the humeral head of the flexor carpi ulnaris muscle was found histologically in cats 4, 5 and 6 and characterized by hypervascularity, increased cellularity, more ground substance, and a loss of collagen continuity (Fig 7).

## DISCUSSION

New bone formation at the medial humeral epicondyle was detected radiographically in 10% of the cats we examined. This finding of bilateral radiographic changes in all affected cats is consistent with previous descriptions of appendicular osteoarthritis in cats, in which bilateral radiographic changes were found in 73% of cats, and the elbow was most commonly affected in 68%.<sup>10,13</sup>

Large semicircular mineralizations of the caudal part of the thickened joint capsule and moderate subluxation of the elbow joint in the 2 severely affected cats represents chronic medial epicondylitis, presumably caused by avulsion of the humeral head of the flexor carpi ulnaris muscle (Figs 3, 6). An association between increased age and feline osteoarthritis has been cited<sup>10-13,16</sup> and the 3 cats in the present study with cartilage defects were all older animals. It is possible that the thickened and partially mineralized joint capsule leads to subluxation of the humeral condyle and subsequent to cartilage defects, but this can only be speculated from our results. Elbow instability was not detected on necropsy examination in any cat and is thus considered an unlikely cause of subluxation.

In people, medial humeral epicondylitis includes pathologic alterations of the musculotendinous origins of the pronator teres muscle and flexor muscles<sup>7,28,29</sup> and represents one of the most common elbow disorders in adults, first described in 1882.<sup>30</sup> Although the term epicondylitis suggests an inflammatory condition, histologic examination demonstrates predominantly tendon degeneration and incomplete reparative

processes following trauma.<sup>7</sup> Likewise, histologic findings in these cats revealed no signs of inflammation in adjacent tissue. Descriptive staging of medial epicondylitis in people has been proposed in which inflammation is present only in the very early stage and fibrosis or calcification at the latest stage.<sup>31</sup> Early stages of epicondylitis in cats often may be overlooked, particularly when radiographic signs of soft tissue mineralization are not already visible.

Epicondylitis appears to be caused by single or repeated trauma because of overuse, jumping from heights, strain, traumatic avulsions of the tendons of origin of the flexor muscles, leading to tendinosis with partial tearing progressing to a full-thickness tendon tear.<sup>31</sup> Human medial epicondylitis is most frequently associated with activities that require repetitive wrist flexion or forearm pronation,<sup>7</sup> and is commonly referred to as little leaguer's elbow or golfer's elbow. Active pronation and supination play an important role in movement in cats, particularly during climbing and capture of prey.<sup>32</sup> Five of the 6 affected cats had outdoor access. Whether this may predispose them to the type of activity that could result in epicondylitis is unclear. The reason that epicondylitis in cats appears to specifically affect the humeral head of the flexor carpi ulnaris muscle is also unclear. However, the flexor carpi ulnaris muscle of cats, and in particular its humeral head, reportedly contains significantly more slow, postural muscle fibers (histochemical fiber type 1) than any of the other forearm muscles.<sup>33</sup> This muscle has the slowest contraction time and be the most important antigravity carpal flexor during stance and locomotion.<sup>34</sup> The anatomic position with a separate insertion at the accessory carpal bone, bearing main stability during carpal extension, and these histochemical

characteristics may explain a greater susceptibility to tendon damage in this muscle above other flexors.

Periarticular enthesiophyte formation at the medial aspect of the elbow joint has been previously documented in cats without correlation between radiographic and histologic features.<sup>8-10,16,24</sup> In 3 cats (cats 1-3), radiographically visible new bone formation at the medial aspect of the elbow joint was not associated with histologic intraarticular abnormalities like cartilage defects (Figs 1,4). Periarticular new bone formation is a potential cause of chronic pain and calcifying tendinosis is cited as a cause of lameness in dogs.<sup>9,17,19-23,35-41</sup> Although previous medical history was not examined, cats with new bone formation at the medial epicondyle on radiographs may show lameness in our experience. Moreover, caudal displacement of the new bone formation and interaction with the joint capsule and ulnar nerve is a potential cause of discomfort; however, further studies are required to correlate clinical findings with radiographic evidence of disease.

In 2 affected cats (cats 4,6) an irregular mineralized body was found close to the cranioproximal aspect of the radial head on mediolateral radiographic projections of both elbows. This finding may be associated with medial humeral epicondylitis but caution in interpreting this finding is warranted, because these mineralizations were clearly located within the annular ligament on histologic examination (Fig 8).

On histologic examination, the ulnar nerve lies in close proximity to the medial humeral epicondyle (Figs 4-6). Pathologic alterations to the epicondyle associated with new bone

formation can lead to nerve displacement and epineural fibrosis, as observed in both elbows in 2 cats (cats 5, 6). Adhesion of the nerve to the periosteum, thickening and distortion of its fascicles and excessive collagen content of the epineurium were present in 2 cats (Fig 6 B) as histologic evidence of chronic nerve degeneration.<sup>42</sup>

In people, the humeroulnar arcade is the aponeurotic band joining the 2 heads of the ulnar carpal flexor muscle, between which the ulnar nerve is situated. When the elbow is flexed, the ulnar nerve may have to sustain high pressures with maximal contraction of the ulnar head of the flexor carpi ulnaris muscle.<sup>43</sup> Indeed, a tenfold increase in pressure between ulnar nerve and muscle was measured during elbow flexion and isometric contraction compared to extension, and mean pressures in patients with more severe nerve lesions were higher than in those with less severe nerve lesions.<sup>43</sup>

In cats, the ulnar nerve is also subjected to a confined position in this area because of the epitrochleoanconeus muscle (Fig 5A), which arises from the medial epicondylar crest and inserts along the caudomedial edge of the olecranon.<sup>44</sup> With medial humeral epicondylitis, the ulnar nerve can be completely enclosed and flattened between the epitrochleoanconeus muscle and new bone formation within the humeral head of the flexor carpi ulnaris muscle (Fig 5A). This pathologic change may have clinical sequelae as nerve damage could result in pain and lameness.

Given these findings and the lack of cartilage damage found histologically in 3 affected cats (cats 1-3), feline medial epicondylitis must be considered as a distinct disorder and

may be presented with or without intraarticular changes. However, epicondylitis may result in the formation of free joint bodies if mineralized structures with origin at the intra-articular part of the medial epicondyle or fragments of degenerated articular cartilage (e.g. incisura trochlearis) become loose and dislocate. This would explain the articular fragment partly attached to the joint capsule adjacent to the caudal edge of the medial epicondyle, observed histologically in cat 4 (Fig 5B).

Early stages of medial epicondylitis in people can be easily overlooked, particularly when radiographic signs of soft tissue mineralization are lacking. In people, ultrasonography is highly sensitive and specific for detection of both early and later stages of clinical medial epicondylitis.<sup>45</sup> Further studies are warranted to evaluate this and other diagnostic imaging modalities in cats.

Given that histologic examination was only performed on elbows with radiographic changes, the prevalence of this medial humeral epicondylitis may be even higher than suggested by our results. Further studies are required to examine the prevalence of histologic signs without radiographic evidence and the correlation of radiographic and histologic findings with clinical signs of disease.

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## FIGURE LEGENDS

Figure 1 Radiographs of the left elbow of a 4-year-old cat (cat 1) with mild medial humeral epicondylitis, showing an irregular edge of the medial epicondyle with rounding (white arrow heads) in extended mediolateral (A) and flexed mediolateral (B) projections and new bone formation (white arrow heads) in the craniocaudal projection (C).

Figure 2 Radiographs of the right elbow of a 13-year-old cat (cat 4) with moderate medial humeral epicondylitis in extended (2A) and flexed mediolateral (2B) and extended craniocaudal (2C) projections showing irregular new bone formation with bony spurs on the medial epicondyle (white arrow heads), a large mineralized free body in the area of the supinator sesamoid bone (white arrow) and subchondral sclerosis of the humeroulnar joint. A slight humeroulnar joint subluxation can be suspected (black arrow head in 2B).

Figure 3 Radiographs of the left elbow of a 16-year-old cat (cat 6) with severe medial humeral epicondylitis in extended (3A) and flexed (3B) mediolateral and extended craniocaudal (3C) projections showing a large semi-circular and partly fragmented periarticular mineralized structure at the caudomedial aspect of the elbow joint (white arrow heads), moderate humeroradial joint subluxation (black arrow head in 3B) and subchondral sclerosis of the humeroulnar joint (black arrow heads in 3C).

Figure 4 A) Photomicrograph of the unaffected elbow of the control cat showing the humeral head (broad black arrows), the ulnar head of the flexor carpi ulnaris muscle (broad black arrow heads) and the thin joint capsule (narrow black arrow) that encloses

the medial humeral epicondyle and is in contact with the ulnar nerve (long black arrow head). The red line in the small photograph in the left lower corner indicates the level of the histologic section. Uncolored specimen. B) Left elbow of cat 1 affected with mild medial humeral epicondylitis (Fig 1) showing a medial epicondylar spur (white arrow head) located at the insertion of the humeral head of the flexor carpi ulnaris muscle (broad black arrows). A thickened joint capsule (narrow black arrow) and caudal displacement of the ulnar nerve (long black arrow head) toward the ulnar head of the flexor carpi ulnaris muscle (broad black arrow heads) are seen. Note the proximity of the distal part of the epitrochleoanconeus muscle (broad white arrows) to the ulnar nerve and the ulnar head of the flexor carpi ulnaris muscle. Giemsa stain.

Figure 5 Photomicrographs of the right elbow of a cat 4 affected with moderate medial humeral epicondylitis (Fig 2) showing in a proximal slice (A) part of an avulsed spur (narrow white arrow head) within the origin of the humeral head of the flexor carpi ulnaris muscle (broad black arrows). A thickened joint capsule (narrow black arrow) is attached to the mineralized structure. Erosive lesions are present and a superficial cartilage flap (broad white arrow heads) has detached acting as a free body. Note the fascicles of the ulnar nerve (long black arrow head) are flattened and in close contact with the avulsed spur. The ulnar head of the flexor carpi ulnaris muscle (broad black arrow heads) as well as the epitrochleoanconeus muscle (broad white arrows) are not involved in this process. In a more distal slice (B), the mineralized structure (white arrow head) appears separated and completely enclosed within the humeral head of the flexor carpi ulnaris muscle (broad black arrows). The free body is now visible (narrow white arrow), partly attached to the thickened joint capsule (narrow black arrow). The fascicles

of the ulnar nerve (long black arrow head) are more distant from the mineralized structure and have regained a more rounded structure. Giemsa stain.

Figure 6 Photomicrographs of the left elbow of cat 6 affected with severe medial humeral epicondylitis (Fig 3) showing (A) humeral osteophytes (narrow white arrow) and a separate extensive ossified structure (narrow white arrow head) apparently partially integrated within the joint capsule. The joint capsule (narrow black arrow) is severely thickened and partially mineralized and the humeral head of the flexor carpi ulnaris muscle (broad black arrows) is displaced medially. Irregular full-thickness cartilage defects (broad white arrow heads) appear partly separated with hypertrophied marginal cartilage layer remodeling of the trochlear notch. Subchondral bone sclerosis is also present. The ulnar nerve (long black arrow head) is pressed and flattened against the ulnar head of the flexor carpi ulnaris muscle (broad black arrow heads). A closer image of the ulnar nerve and its surroundings (B) shows flattening and caudal compression of nerve fascicles (long black arrow head) from extensive ossified masses (long white arrow head) toward the ulnar head of the flexor carpi ulnaris muscle (broad black arrow heads). The epineurium (small white arrow heads) is thickened, adheres to the reactive periosteum (white arrow) and shows increased collagen content. Intense Giemsa stain.

Figure 7 Photomicrographs of a longitudinal histologic slice of a left elbow of cat 4, affected with moderate medial humeral epicondylitis. A) shows the ulnar nerve (black arrow head) near the origin of the humeral head of the flexor carpi ulnaris muscle (broad black arrows) and islands of mineralization (white arrow head) within the tendon are



present. The tendon is closely connected to the thickened joint capsule (narrow black arrow). The white square area placed over the tendon is magnified in B. The red line in the small picture on the left lower corner indicates the level of the histologic section. B) higher magnification of the area depicted by a white square in A, showing increased cellularity, ground substance and vascularity, and the loss of collagen continuity as evidence of tendinosis. Weak Giemsa stain.

Figure 8 Photomicrographs of a transverse histologic slice of the right elbow in cat 4 affected with moderate medial humeral epicondylitis (Fig 2A). A mineralized body is present, cranial to the radial head (A, white arrow head). A higher magnification (B) shows a rounded mineralized structure (white arrow head) within the annular ligament (white arrows). The joint capsule (black arrow) is in close contact with the annular ligament but clearly distinct from it. Giemsa stain.

**Table 1.** Findings in 6 Cats with new bone formation at the insertion of the humeral head of the flexor carpi ulnaris muscle. Severity was defined as mild, moderate or severe (see Materials and Methods).

		Cat 1	Cat 2	Cat 3	Cat 4	Cat 5	Cat 6
Age (years)		4	4.5	5.5	13	15.5	16
Outdoor access		Yes	Yes	Yes	No	Yes	Yes
Body weight (kg)		5.1	4.1	3.4	8.7	4.8	4.0
Severity		mild	mild	moderate	moderate	severe	severe
<i>Radiographic findings</i>	<i>Histologic findings</i>						
Joint subluxation		No	No	No	mild	moderate	moderate
	Tendinosis	No	No	No	Yes	Yes	Yes
	Ulnar nerve displacement and epineural fibrosis	No	No	No	No	Yes	Yes
Mineralized body close to the cranio-proximal aspect of the radial head.	Mineralized body within the annular ligament.	No	No	No	Yes	No	Yes
	Free intraarticular mineralized body.	No	No	No	Yes	No	No